U.S. Department of the Interior
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Natural Resource Stewardship and Science Directorate
Geologic Resources Division

Sagamore Hill National Historic Site

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Sagamore Hill National Historic Site

sahi_geology.pdf

Version: 4/4/2014

Geologic Resources Inventory Map Document for Sagamore Hill National Historic Site

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Geologic Resources Inventory Map Document

Sagamore Hill National Historic Site, New York

Document to Accompany Digital Geologic-GIS Data

sahi_geology.pdf

Version: 4/4/2014

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Sagamore Hill National Historic Site, New York (SAHI).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

National Park Service (NPS) Geologic Resources Inventory (GRI) Program staff have assembled the digital geologic-GIS data that accompanies this document.

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About the NPS Geologic Resources Inventory Program

Background

Recognizing the interrelationships between the physical (geology, air, and water) and biological (plants and animals) components of the Earth is vital to understanding, managing, and protecting natural resources. The Geologic Resources Inventory (GRI) helps make this connection by providing information on the role of geology and geologic resource management in parks.

Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The Geologic Resources Inventory aims to raise awareness of geology and the role it plays in the environment, and to provide natural resource managers and staff, park planners, interpreters, researchers, and other NPS personnel with information that can help them make informed management decisions.

The GRI team, working closely with the Colorado State University (CSU) Department of Geosciences and a variety of other partners, provides more than 270 parks with a geologic scoping meeting, digital geologic-GIS map data, and a park-specific geologic report.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm

Geologic Reports: Park-specific geologic reports identify geologic resource management issues as well as features and processes that are important to park ecosystems. In addition, these reports present a brief geologic history of the park and address specific properties of geologic units present in the park.

For a complete listing of Geologic Resource Inventory products and direct links to the download site visit the GRI publications webpage http://www.nature.nps.gov/geology/inventory/gre_publications.cfm

GRI geologic-GIS data is also available online at the NPS Data Store Search Application: http://irma.nps.gov/App/Reference/Search. To find GRI data for a specific park or parks select the appropriate park (s), enter “GRI” as a Search Text term, and then select the Search Button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: http://www.nature.nps.gov/geology/inventory, or contact:

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GRI Digital Maps and Source Map Citations

The GRI digital geologic-GIS maps for Sagamore Hill National Historic Site, New York (SAHI):

GRI Digital Geologic Map for Sagamore Hill NHS and Vicinity, New York *(GRI MapCode SAHI)*

Isbister, John, 1966, Geology and Hydrology of Northeastern Nassau County, Long Island, New York: U. S. Geological Survey, Water-Supply Paper 1825, scale 1:48,000. (Water-Supply Paper 1825). (*GRI Source Map* 27853)

Lubke, E.R., 1964, Hydrogeology of the Huntington - Smithtown Area, Suffolk County, New York: U.S. Geological Survey, Water-Supply Paper 1669-D, scale 1:62,500. (Water-Supply Paper 1669-D). (*GRI Source Map* 28078)

GRI Digital Geomorphologic Map for Sagamore Hill NHS and Vicinity, New York *(GRI MapCode SAHG)*

Psuty, N. P. et al., 2014, Geomorphological Map for Sagamore Hill National Historic Site and Vicinity, New York: Institute of Marine and Coastal Sciences, Rutgers University, Sandy Hook, NJ, unpublished digital data and map, scale 1:6,000. (Geomorphological Map of Sagamore Hill NHS). (*GRI Source Map 75635*)

Additional information pertaining to each source map is also presented in the GRI Source Map Information (SAHIMAP) table included with the GRI geology-GIS data.

GRI Digital Geologic Map for Sagamore Hill NHS and Vicinity

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Sagamore Hill National Historic Site, New York (SAHI) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qaf - Artificial fill). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geologic Unit Information (SAHIUNIT) table included with the GRI geology-GIS data.

Cenozoic Era

Quaternary Period

Recent
Qaf - Artificial fill
Qsh - Shoreline deposits
Qal - Alluvial deposits
Qm - Marsh deposits

Pleistocene Epoch
Qhgm - Harbor Hill ground moraine deposits
Qhtm - Harbor Hill end moraine deposits

Mesozoic Era

Cretaceous Period
Ku - Cretaceous outcrops, undifferentiated

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below.

Qaf - Artificial fill (Recent)

Geologic Unit: Recent deposits: Artificial fill, salt-marsh deposits, stream alluvium, and shoreline deposits.

Approximate thickness (feet) - 0-50

Depth from land surface to top (feet) - 0

Character of Deposits:
Sand, gravel, silt, and clay; organic mud, peat, loam, and shells. Colors are gray, green, black, and brown.

Water-bearing properties:
Generally permeable deposits near shoreline and stream-channel deposits may yield small quantities of fresh or brackish water at shallow depths. Clay and silt beneath Long Island Sound and its

harbors retard salt-water encroachment and confine water in underlying aquifers.

(GRI Source Map ID 27853) (Water-Supply Paper 1825).

Qsh - Shoreline deposits (Recent)

Qsh - Shoreline deposits (Recent)

Chiefly well-sorted sand and gravel deposited by current and wave action as beaches, spits, and bars

Geologic unit: Recent deposits: Artificial fill, salt-marsh deposits, stream alluvium, and shoreline deposits.

Approximate thickness (feet) - 0-50

Depth from land surface to top (feet) - 0

Character of Deposits:
Sand, gravel, silt, and clay; organic mud, peat, loam, and shells. Colors are brown, yellow , and gray

Water-bearing properties:
Sandy and gravelly beach deposits may locally yield small supplies of fresh to brackish water to wells. Marine silt and clay in north-shore harbors retard salt-water encroachment and confine underlying aquifers.

(GRI Source Map ID 28078) (Water-Supply Paper 1669-D).

Qb - Beach deposits (Recent)

Sand, gravel, and some boulders

Approximate thickness (feet) - 0-50

Depth from land surface to top (feet) - 0

Character of Deposits:
Sand, gravel, silt, and clay; organic mud, peat, loam, and shells. Colors are gray, green, black, and brown.

Water-bearing properties:
Generally permeable deposits near shoreline and stream-channel deposits may yield small quantities of fresh or brackish water at shallow depths. Clay and silt beneath Long Island Sound and its harbors retard salt-water encroachment and confine water in underlying aquifers.

(GRI Source Map ID 27853) (Water-Supply Paper 1825).

Qal - Alluvial deposits (Recent)

Stream-deposited sand and silt; may contain organic material.

Geologic unit: Artificial fill, salt-marsh deposits, stream alluvium, and shoreline deposits.

Approximate thickness (feet) - 0-50

Depth from land surface to top (feet) - 0

Character of Deposits:
Sand, gravel, silt, and clay; organic mud, peat, loam, and shells. Colors are gray, green, black, and brown.

Water-bearing properties:
Generally permeable deposits near shoreline and stream-channel deposits may yield small quantities of fresh or brackish water at shallow depths. Clay and silt beneath Long Island Sound and its harbors retard salt-water encroachment and confine water in underlying aquifers.

(GRI Source Map ID 27853) (Water-Supply Paper 1825).

Qm - Marsh deposits (Recent)

Qm - Marsh deposits (Recent)

Clay, silt, sand and organic matter

Geologic unit: Recent deposits: Artificial fill, salt-marsh deposits, stream alluvium, and shoreline deposits.

Approximate thickness (feet) - 0-50

Depth from land surface to top (feet) - 0

Character of Deposits:
Sand, gravel, silt, and clay; organic mud, peat, loam, and shells. Colors are brown, yellow , and gray

Water-bearing properties:
Sandy and gravelly beach deposits may locally yield small supplies of fresh to brackish water to wells. Marine silt and clay in north-shore harbors retard salt-water encroachment and confine underlying aquifers.

(GRI Source Map ID 28078) (Water-Supply Paper 1669-D).

Qm - Marsh deposits (Recent)

Sand, silt, and clay mixed with decaying plant debris accumulated in marshy areas.

Geologic unit: Recent deposits: Artificial fill, salt-marsh deposits, stream alluvium, and shoreline deposits.

Approximate thickness (feet) - 0-50

Depth from land surface to top (feet) - 0

Character of Deposits:
Sand, gravel, silt, and clay; organic mud, peat, loam, and shells. Colors are gray, green, black, and brown.

Water-bearing properties:
Generally permeable deposits near shoreline and stream-channel deposits may yield small quantities of fresh or brackish water at shallow depths. Clay and silt beneath Long Island Sound and its harbors retard salt-water encroachment and confine water in underlying aquifers.

(GRI Source Map ID 27853) (Water-Supply Paper 1825).

Qhgm - Harbor Hill ground moraine deposits (Pleistocene)

Qgm - Ground moraine and retreatal outwash (Pleistocene)

Till and some stratified sand and gravel

Geologic unit: Upper Pleistocene deposits

Approximate thickness (feet) - 0-300

Character of Deposits:
Till composed of unassorted clay, sand, and boulders as ground moraine in area north of Harbor Hill terminal moraine and possibly as buried ground moraine of Ronkonkoma ice.
Outwash deposits of brown well-stratified sand and gravel-predominantly quartzose but containing biotite and other dark minerals and igneous and metamorphic rock fragments-including advance outwash, channel and valley-fill, and outwash-plain deposits.
Ice-contact deposits of crudely stratified sand and gravel and isolated masses of till in the Ronkonkoma and Harbor Hill terminal moraines.
Glaciolacustrine deposits of brown and gray silt nand clay intercalated with outwash deposits in buried valleys.

Water-bearing properties:
Till, relatively impermeable; commonly causes perched water bodies to form locally and impedes recharge from precipitation. Outwash and ice-contact deposits are moderately to highly permeable. Wells screened in outwash deposits generally at depths of less than 25 ft yield as much as 1700 gpm. Specific capacities of public-supply wells range form 22 to 222 gpm per ft of drawdown. Water is generally fresh and unconfined. Chief source of water for domestic, public-supply, industrial, and irrigation wells in project area. Glaciolacustrine deposits of silt and clay are relatively impermeable and locally retard movement of water between adjacent water-bearing beds in Pleistocene and Cretaceous deposits.

(GRI Source Map ID 28078) (Water-Supply Paper 1669-D).

Qhgm - Harbor Hill ground moraine deposits (Pleistocene)

Chiefly till; unsorted mixture of clay, sand, and boulders deposited by glacial ice; forms a thin veneer over area north of Harbor Hill terminal moraine; average thickness 5-10 feet, locally as much as 40 feet thick.

Geologic unit: Harbor Hill drift

Approximate thickness (feet) - 0-200

Depth from land surface to top (feet) - 0-50

Character of Deposits:
Glacial till composed of unassorted clay, sand, and boulders. In Harbor Hill terminal moraine and ground moraine to north. Glacial outwash deposits of stratified brown sand and gravel.

Water-bearing properties:
Glacial till, generally low permeability. Causes perched water locally and impedes downward percolation of water to underlying beds. Highly permeable outwash deposits of sand and gravel forms upper part of principal aquifer. Wells screened in outwash deposits yield as much as 1,100 gpm and have specific capacities ranging from 1 to 68 gpm per foot of draw down. Water is generally unconfined and is of good quality.

(GRI Source Map ID 27853) (Water-Supply Paper 1825).

Qhtm - Harbor Hill end moraine deposits (Pleistocene)

Thick accumulation of unsorted till and stratified sand and gravel; marks stationary front of an ice sheet.

Geologic unit: Harbor Hill drift

Approximate thickness (feet) - 0-200

Depth from land surface to top (feet) - 0-50

Character of Deposits:
Glacial till composed of unassorted clay, sand, and boulders. In Harbor Hill terminal moraine and ground moraine to north. Glacial outwash deposits of stratified brown sand and gravel.

Water-bearing properties:
Glacial till, generally low permeability. Causes perched water locally and impedes downward percolation of water to underlying beds. Highly permeable outwash deposits of sand and gravel forms upper part of principal aquifer. Wells screened in outwash deposits yield as much as 1,100 gpm and have specific capacities ranging from 1 to 68 gpm per foot of draw down. Water is generally unconfined and is of good quality.

(GRI Source Map ID 27853) (Water-Supply Paper 1825).

Ku - Cretaceous outcrops, undifferentiated (Cretaceous)

K - Magothy (?) Formation (Upper Cretaceous)

Sand, sandy clay, clay and some gravel; gray

Geologic unit: Magothy (?) Formation

Approximate thickness (feet) - 0-800

Character of Deposits:
Sand, clayey, with silt, clay, and some gravel. Colors are white, gray, brown, yellow, and red. The upper part of the formation commonly includes interbedded clay, fine to medium sand, silt, and some lignite; the lower part is largely coarse sand, gravel, and some clay.

Water-bearing properties:
Generally ranges from moderately to highly permeable. The lower part of the formation is more permeable than the upper part. Several public-supply wells screened in the basal zone have yields ranging from 1,000 to 1,500 gpm and specific capacities from 30 to 90 gpm per ft of draw down. Water is generally of excellent quality. Second most important source of water to wells. Unconfined conditions are common in uppermost part of formation, but confined conditions prevail in the lower part; some wells flow.

(GRI Source Map ID 28078) (Water-Supply Paper 1669-D).

K - Cretaceous outcrop (Cretaceous)

Exposures of sand, clayey sand, and clay of various colors containing lignitic and ferruginous concretions; commonly deformed by ice movement

Geologic unit: Magothy (?) Formation

Approximate thickness (feet) - 0-800

Depth from land surface to top (feet) - 0-350

Character of Deposits:
Sand, fine to medium, clayey, white, gray, pink, and yellow. Interbedded with lenses and layers of coarse sand and sandy and solid clay. Gravel common in basal 50 to 100 ft of formation. Lignite, pyrite, and iron concretions are common.

Water-bearing properties:
Contains relatively impermeable to highly permeable zones. Wells screened in basal zone yield as much as 1,400 gpm. Specific capacities of wells commonly range from 15 to 30 gpm per foot of drawdown but may be as low as 1 or as high as 83. Principal source for public supply. Water is generally of excellent quality. Degree of confinement increases with depth. Forms most of principal aquifer.

(GRI Source Map ID 27853) (Water-Supply Paper 1825).

GRI Source Map Information

Water-Supply Paper 1669-D

Lubke, E.R., 1964, Hydrogeology of the Huntington - Smithtown Area, Suffolk County, New York, U.S. Geological Survey, Water-Supply Paper 1669-D, 1:62500 scale (*GRI Source Map ID 28078*).

Note: The GRI digital geologic map for Sagamore Hill NHS used a subset of information from this publication. Additional aquifer and well data, as well as complete cross sections, can be viewed at the U.S. Geological Survey Publications Warehouse http://pubs.er.usgs.gov/publication/wsp1669D.

Plate 2 of 6 (Geologic contacts and units) and plate 3 of 6 (Structure contours) from the Geologic Map of the Huntington - Smithtown Area, Suffolk County, New York were used to produce the GRI digital geologic-GIS map for Sagamore Hill National Historic Site, New York (SAHI).

WSP-1669-D Report

The following is an extract of geologic information from Water-Supply Paper 1669-D. Tables and figures referred to in this text are not included. To view tables and figures associated with Water-Supply Paper 1669-D, and a complete version of that publication, please go to the U.S. Geological Survey Publications Warehouse at: http://pubs.er.usgs.gov/publication/wsp1669D.

The Huntington-Smithtown area is underlain by 400 to 1,300 feet of unconsolidated deposits of Cretaceous, Tertiary (?), and Quaternary age resting upon a surface of southeast-sloping bedrock. The bedrock is probably of igneous and metamorphic origin and of Precambrian to early Paleozoic age, as in other parts of Long Island. Deposits of Late Cretaceous age rest unconformably upon the bedrock surface. A summary of the stratigraphic sequence in the Huntington-Smithtown area is given in table 2.

The Raritan formation of Late Cretaceous age is the oldest unconsolidated deposit. This formation is divided into a basal Lloyd sand member and an upper clay member, which is generally overlain by the Magothy (?) formation, also of Late Cretaceous age. Pliocene (?) deposits (Suter and others, 1949, footnote p. 9) are represented by the Mannetto gravel, remnants of which lie on the Magothy (?) formation chiefly in the Mannetto Hills of eastern Nassau County and in the West Hills of the Town of Huntington.

Deposits of Pleistocene age belonging to one or more glacial stages and one interglacial stage have been recognized in Long Island, but not all these have been identified in the Huntington-Smithtown area. The Jameco gravel, an early glacial-outwash deposit of pre-Wisconsin age, is widely distributed in western Long Island where it is recognized entirely in well logs (Suter and others, 1949, pl. 20). It may also be present in some of the deeper buried valleys of the Huntington-Smithtown area but has not been positively identified. An interglacial shallow marine deposit, the Gardiners clay, has been recognized in western and central Long Island. (See Suter and others, 1949, pls. 17 and 21, and Weiss, 1954.) This formation, also of pre-Wisconsin age, was deposited around the margins of Long Island when sea level was about 50 feet lower than it is now. The Gardiners or its nonmarine equivalent may be present in some deep buried valleys of the project area, but it has not been recognized separately in well logs because of its lithologic similarity to younger clay of probable glaciolacustrine origin. Glacial deposits of the Wisconsin stage, also termed upper Pleistocene deposits in this report, constitute the bulk of the Pleistocene sequence. These deposits generally rest directly on the deposits of Cretaceous age and locally on the Mannetto gravel of Pliocene (?) age or on undifferentiated deposits of Pleistocene age.

The glacial origin of the surficial Pleistocene deposits is indicated by two morainal ridges, which traverse the length of the project area (pl. 2). The Ronkonkoma terminal moraine in the south marks the maximum advance and its northern counterpart, the Harbor Hill end moraine, mark a second position of an ice sheet, which covered much of Long Island during the Wisconsin glacial stage. In the Huntington-Smithtown area the stratification and morphology of the deposits in these ridges indicate that they are chiefly coalescing kame-type structures formed along a relatively stationary ice front. In Huntington the Ronkonkoma moraine lies on the northern fringe of the West Hills and rests on the Mannetto gravel. A surficial till sheet attaining a thickness generally no greater than about 10 feet is common on upland surfaces of the project area north of the Harbor Hill moraine. Surficial deposits of sand and gravel, laid down by melt-water streams issuing from the ice front, form a pitted outwash plain in the intermorainal belt between the ridges formed by the Harbor Hill and Ronkonkoma moraines and a relatively smooth south-sloping outwash plain south of the Ronkonkoma moraine.

Deposits of Recent age are thin and are limited chiefly to shoreline areas.

BEDROCK

The lower limit of the ground-water reservoir in the Huntington-Smithtown area is marked by an erosional surface on a complex of igneous and metamorphic rocks, which are of Precambrian and possibly early Paleozoic age. The bedrock underlying Long Island is composed chiefly of granite, diorite, gneiss, and schist.

Evidence of the nature of the bedrock in the Huntington-Smithtown area is available only from two wells, S34 (U.S. Geol. Survey, 1938, p. 25) and N3355 (pl. 4). Well S34 (pl. 4) on Duck Island southeast of Eatons Neck is reported to have penetrated bedrock at 602 feet below land surface (597 ft below sea level). The driller's report described the bedrock as a "sandstone." If this description is correct, this occurrence would be the only sandstone bedrock recorded in Long Island. It is likely however, that the driller's description is in error and that the material described as "sandstone" is actually weathered igneous or metamorphic rock. Weathered bedrock, 1,218 feet below the land surface (1,035 ft below sea level), also was penetrated in well N3355 situated in Nassau County near the western limit of the project area. The general composition of the weathered material at this site suggests igneous and metamorphic parent rocks, which are common in other parts of Long Island.

The weathered zone above the fresh rock is regarded as lateritic and probably formed immediately prior to the deposition of the Cretaceous sediments. The weathered zone is generally composed of variegated clay containing partly decomposed fragments of bedrock. It ranges in thickness from 5 to 100 feet (Suter and others, 1949, p. 13).

The bedrock surface, striking east-northeast, is a relatively smooth plane which slopes at about 80 feet per mile southeastward across the Huntington-Smithtown area (Suter and others, 1949, pl. 8). This surface ranges from about 400 feet below sea level in the northwestern part of the project area to about 1,300 feet below sea level in the vicinity of Lake Ronkonkoma. Owing to the low permeability, the water-yielding potential of the bedrock is poor in comparison with that of the overlying unconsolidated deposits. Consequently, the bedrock is not considered to be a source of ground water.

UPPER CRETACEOUS SERIES

In the Huntington-Smithtown area, as elsewhere on Long Island, deposits of Late Cretaceous age are divided into two formations, the Raritan formation and the overlying Magothy (?) formation, which is in part equivalent to the Magothy formation of New Jersey. This sequence of deposits is composed of interbedded layers of sand, gravel, silt, and clay that dip gently to the southeast subparallel to the slope of the underlying bedrock surface. The Raritan and Magothy (?) formations were probably deposited largely by sluggish streams in a low swampy coastal-plain environment. However, marine facies may be present, at least locally, in these deposits, if one report of fossils is correct. According to Veatch and Bowman (1906, p. 297), a crinoid stem and a bryozoan were found in samples taken from a depth of 247 feet in well S230 (pl.4). These marine fossils in the Lloyd sand member of the Raritan formation are considered to be of Late Cretaceous age. Marine beds, possibly correlative with the Monmouth Group, also have been identified in the upper part of the Magothy (?) formation in southwestern Suffolk County (Perlmutter and Crandell, 1959, p. 1066). The Cretaceous deposits generally increase in thickness southeastward. The deposits, however, were deeply dissected by stream erosion during Tertiary and probably early Pleistocene time and the resulting erosional surface on the Cretaceous in the project area has relief which in places exceeds 500 feet (pl. 3). This surface was subsequently buried by Pleistocene glacial and marine deposits, although the Cretaceous is covered by younger deposits in virtually the entire project area, small outcrops occur near sea level in bluffs and along the beaches on the north shore of Lloyd Neck, on the west side of Eatons Neck, and on the east side of Cold Spring Harbor (pl. 3). One small outcrop also was observed in an excavation in the West Hills at an altitude of 250 feet (pl. 3). The geologic relations of the Cretaceous and younger deposits are shown in plate 4.

RARITAN FORMATION

The Raritan formation probably is present throughout the Huntington-Smithtown area according to available well logs. The upper surface of the Raritan, which also is the upper surface of the clay member, slopes southeastward. It has considerable relief in the northern part of the area. This relief is the result of post-Cretaceous erosion. The upper surface of the clay member is about 100 feet below sea level in the northwestern part of Lloyd Neck (pl. 4) and is about 700 feet below sea level in the vicinity of Lake Ronkonkoma (pl. 4). In the same localities the top of the Lloyd sand member ranges from 200 to 850 feet below sea level. Approximate contours on the surface of the Lloyd sand member and of the clay member are given in Suter and others (1949, pls. 11, 12, 14, and 15). Depths to the top of these surfaces also are shown in the geologic sections (pl. 4).

The Lloyd sand member rests unconformably on bedrock in most of the area, and has been penetrated completely by test well N3355 (pl. 4), which is in Nassau County just west of the project area. At this site the total thickness of the Lloyd is 265 feet. In the Huntington-Smithtown area the Lloyd presumably is penetrated entirely by well S34, but no log is available. Several other wells (S9, S217, S230, and 54467, pl. 4) have been drilled 50 to 120 feet into the Lloyd. The logs of these wells suggest that the Lloyd consists chiefly of lenses of fine to coarse sand and gravel but that it contains clay and silt as thin layers or as intergranular fillings. The color of the Lloyd sand member is generally white and gray, but in a few places it is pale yellow.

The clay member of the Raritan, which overlies the Lloyd sand member, is composed chiefly of beds of variegated clay and silt, which contain interbedded layers of sand in some places. Lignite in dispersed fragmental form and iron oxide and pyrite nodules are also common. The clay member ranges in thickness from 0 to 188 feet and averages about 170 feet. In general, well logs indicate that the thickness and physical character of the clay member are relatively uniform throughout the Huntington-Smithtown area (pl. 4).

The clay member of the Raritan generally consists of material of relatively low permeability and acts as an aquiclude, which confines water in the underlying Lloyd and retards interchange of water with the overlying Magothy (?) formation.

The Lloyd sand member is a significant source of water in Queens and Nassau Counties, where wells may yield as much as 1,600 gpm (gallons per minute). The Lloyd has not been developed extensively in Suffolk County. Several domestic and public-supply wells are screened in the Lloyd in the northern part of the Town of Huntington. The record of a typical well tapping the Lloyd is given in table 1. Because of the lack of data, it is not possible to estimate directly the hydraulic properties of the Lloyd sand member in the Huntington-Smithtown area. Swarzenski (1961, p. 27), however, has made estimates indicating that the coefficient of permeability (Wenzel and Fishel, 1942, p. 7) of the water-bearing zones in the Lloyd sand member in northwestern Nassau County may range from 200 to 600 gpd (gallons per day) per sq ft. Comparable coefficients of permeability also may be expected in the project area. In 1957, pumpage from the Lloyd sand member accounted for only about 3 percent of the total pumpage for public supply and industrial use in the Huntington-Smithtown area.

MAGOTHY (?) FORMATION

The Magothy (?) formation rests on the top of the Raritan formation and underlies most of the Huntington-Smithtown area. The upper limit of the Magothy (?) is marked by a highly irregular erosional surface (pl. 3), upon which rest deposits of Pleistocene and in some places Pliocene(?) age. The maximum relief on this surface is greater than 500 feet. This surface on the Magothy (?) formation has a maximum known altitude of about 250 feet in the West Hills area, but in several areas it lies 200 feet or more below sea level. The Magothy (?) formation is as much as 800 feet below sea level near the southern limit of the Huntington-Smithtown area, but data from well logs and samples suggest that in several places the formation is missing, as for example, in the Huntington buried valley (pl. 4).

The upper part of the Magothy (?) formation is composed mostly of layers of fine to medium quartz sand, generally somewhat clayey and interbedded with layers of clay and silt. (See the following well logs.) Gravelly layers, which occur in a few places, appear to be lenticular and have relatively small areal extent. Colors range through white, gray, brown, yellow, and red, but the sandy layers generally have a somewhat lighter color owing to the presence of intergranular fillings of white clay. Lignite in fragmental form and pyrite and iron oxide nodules are commonly dispersed throughout the formation.

The lower part of the Magothy (?) formation becomes increasingly coarser textured at depth, as indicated by the greater frequency of gravelly layers. Several wells, which have penetrated the basal zone of the Magothy (?), have penetrated thick layers of gravel intercalated with layers of finer grained sediments (pl. 4). This gravelly zone, which appears to be present through most of the project area, rests directly on the clay member of the Raritan. It crops out in bluffs along the northwest coast of Lloyd Neck (pl. 2). The upper limit of the gravelly zone is poorly defined but is presumably gradational into finer grained sediments characteristic of the upper part of the Magothy (?) . The maximum thickness of this zone is about 200 feet.

Most of the wells in the project area that penetrate Cretaceous deposits are screened in the upper part of the Magothy (?) formation, where the preponderance of fine-grained materials limits the water-yielding capacity of the wells. Locally, there are more productive water-bearing zones, but these are generally of small vertical and lateral extent. The basal part of the Magothy (?) is the most productive water-yielding zone of the formation. Although relatively few wells were screened in this zone in 1960, test-well data indicate conditions favorable for development to meet future water demands. The Magothy (?) formation is the second most important source of water tapped by industrial and public-supply wells in the project area - particularly in or near the following localities: Centerport, Cold Spring Harbor, East Northport, Greenlawn, Indian Head, Kings Park, Melville, Smithtown, and South Commack. In or near these localities individual wells screened in the Magothy (?), at depths ranging from 246 to 593 feet, yield from 600 to 1,700 gpm. The specific capacity of individual wells ranges from 16 to 86 gpm per foot of drawdown and generally is somewhat lower than that of wells tapping water-bearing material in the Pleistocene deposits. The coefficients of transmissibility of the Magothy (?) water-bearing material were computed from the specific capacity (Theis and others, 1954) of typical public-supply wells. On the basis of these values of transmissibility and an estimated thickness of aquifer, the computed coefficients of permeability ranged from 450 to 750 gpd per sq ft (table 3). In 1957, approximately 44 percent of the total withdrawal for public supply and industrial use in the Huntington- Smithtown area was pumped from the Magothy (?) formation.

PLIOCENE (P) SERIES

MANNETTO GRAVEL

The type area of the Mannetto gravel is the Mannetto Hills of eastern Nassau County. Crosby correlated these deposits with the Lafayette gravel of late Pliocene age. Fuller (1914, p. 85) considered the deposits to be remnants of a glacial outwash sheet of early Pleistocene age. The author has found no new evidence to support either interpretation of the age of this unit. The Geological Survey considers the Mannetto to be of Pliocene (?) age (Suter and others, 1949, footnote p. 9).

The Mannetto gravel has been identified by the author only in Huntington in exposures in the southern part of the West Hills where it rests on the buried Cretaceous surface. Other small outcrops were mapped by Fuller (1914, pl. 1) in the Dix Hills and several other places in the project area. These are not shown on plate 2 as the author was unable to confirm their presence. The Mannetto has also been correlated in a few well records (pl. 4).

In surficial exposures in the West Hills, the Mannetto gravel is largely composed of current-bedded quartz sand and gravel and, in places, layers of clay. The sand grains and the pebbles are commonly pitted. Rarely, weathered igneous and metamorphic rock and ferruginous sandstone fragments are present in the deposits. The color of the Mannetto gravel ranges from light brown to orange brown. The preponderance of quartz and the scarcity of dark minerals and rock particles is characteristic of the Mannetto, as contrasted with the heterogenous composition of the upper Pleistocene deposits.

In most places the base of the Mannetto gravel rests on Cretaceous deposits at altitudes well above sea level (pl. 4). The Mannetto generally lies above the water table and consequently is of little importance as a source of water. Locally, however, some of the formation may lie in the zone of saturation and, in such places, may be a source of water. For example, well S4 (U.S. Geol. Survey, 1938, p. 12) reportedly penetrated 347 feet of sand and gravel that is probably partly of Mannetto age.

The static water level in the well is reported to be 298 feet below the land surface. This unusually thick section of sand and gravel appears to lie in a narrow and steep-sided tributary of the Huntington buried valley. The floor of this tributary is near or s1ightly above sea level. Well S927 (Roberts and Brashears, 1945, p. 40), located north-northeast of well S4, penetrated 300 feet of coarse sand and gravel of probable Mannetto age before reaching the Cretaceous. Elsewhere, the Mannetto gravel has not been identified in deep wells, although it may be present in some buried valleys. Presumably, most of the Mannetto was dissected and removed by erosion prior to the deposition of the upper Pleistocene sequence.

PLEISTOCENE SERIES

Deposits of Pleistocene age mantle Cretaceous formations almost everywhere, but in a few places they rest on Pliocene (?) deposits. The thickness of the Pleistocene deposits ranges from 0 to more than 650 feet and averages 200 feet. Within the project area, these deposits may include three Pleistocene depositional sequences. The Jameco gravel and Gardiners clay, which are of post-Mannetto age, underlie deposits of the Wisconsin glacial stage in some deep buried valleys of northwestern Nassau County (Swarzenski, 1961, p. 33-34, and p. 42). Similar sequences have not been identified in the Huntington- Smithtown area, although some of the silt and clay bodies and the associated sand and gravel deposits in buried valleys may be equivalent to the Gardiners clay and the Jameco gravel. In this report these two formations are included with undifferentiated deposits largely of Pleistocene age that may also include deposits of Tertiary (?) age in some places. The bulk of the Pleistocene deposits belong to the latest sequence laid down during the Wisconsin glacial stage and are referred to in this report as upper Pleistocene deposits.

The thickness and distribution of Pleistocene deposits were chiefly controlled by an older, now buried topography formed on the Cretaceous surface. This topography was the product of stream erosion, which probably began during the Tertiary and was later modified by overriding ice sheets and melt-water streams during the Pleistocene epoch. Information from well logs in the Huntington-Smithtown area indicates that a series of deep valleys were cut in the buried Cretaceous surface (pl. 3). Although the main buried valleys generally slope northward, major tributaries flow along east-west lines - presumably along softer, less resistant beds in the Cretaceous.

Because of the lack of well data, the shape, depth, and extent of most of the buried valleys can be defined only approximately. In western Huntington the presence of a particularly deep valley (Huntington buried valley) was established from correlation of well logs and cores taken at wells S16137T, S14675T, S15190, and S16049T (pl. 4). At well S16137T, 604 feet of deposits of Pleistocene and possibly Tertiary age were penetrated without reaching the Cretaceous. This test well penetrated the greatest thickness of Pleistocene deposits known in the project area. At well S14675T the basal gravel zone of the Magothy (?) formation was penetrated at 314 feet below sea level beneath 534 feet of post-Cretaceous deposits - probably all of Pleistocene age. The axis of this valley probably sloped northward, and in the northern reach of the valley the Magothy (?) formation and the clay member, and possibly even the Lloyd sand member, of the Raritan formation may have been completely removed by erosion. In the Northport area, evidence of another deep valley (Northport buried valley) was disclosed by core samples from well S11105, where 545 feet of Pleistocene deposits was penetrated to a depth of 370 feet below sea level. In Smithtown the axis of a deep buried valley is poorly defined, owing to lack of deep-well data. However, several wells (pl. 4) in this valley have penetrated Pleistocene deposits to depths as great as 300 feet below the land surface, of 185 feet below sea level.

The Pleistocene deposits are predominantly composed of stratified sand and gravel, although thick layers of nonmarine silt and clay occur in the buried valleys, and a thin surficial mantle of unstratified glacial till is common on the uplands north of the Harbor Hill terminal moraine. The sand and gravel are largely composed of quartz, but igneous and metamorphic rock fragments and biotite, hornblende, and augite are also generally present. The colors of the deposits are generally brown, yellow, or gray. An extensive Pleistocene clay unit has been identified in several wells in the major buried valley, which extends beneath most of Smithtown (pl. 4, and fig. 3). Locally, thick but discontinuous clay bodies of Pleistocene age also have been penetrated in wells in other parts of the project area. In general, they lie in the larger buried valleys, the floors of which are commonly below sea level. The clay unit of Smithtown and the other discontinuous clay bodies may include equivalents of the Gardiners clay, as well as glaciolacustrine deposits laid down during the Wisconsin glacial stage. All these clay deposits are intercalated with coarse sand and gravel.

The saturated sand and gravel beds in the Pleistocene deposits yield moderate to large supplies of water to properly constructed wells, but the clay bodies act as local confining beds for water-bearing zones in Pleistocene sand and gravel and also in places for water in the Cretaceous deposits. The Pleistocene deposits constitute the most important source of water in the project area for numerous small domestic wells and also for industrial and public-supply wells in and near the villages of Centerport, Dix Hills, Greenlawn Manor, Hauppauge, Huntington Station, Northport, and South Huntington. In these localities, individual public-supply wells screened in water-bearing sand and gravel beds of Pleistocene age at depths ranging from 100 to 602 feet yield from 1,000 to 1,700 gpm. Specific capacities of these wells range from 31 to 221 gpm per foot of drawdown and on the average are higher than those of wells tapping the Cretaceous deposits. Transmissibilities of Pleistocene water-bearing materials tapped by typical public-supply wells were computed from specific capacities (Theis and others, 1954). By the use of these values and the estimated thickness of the aquifer, permeabilities ranging from 750 to 1,500 gpd per sq ft (table 3) were computed. In 1957, ground-water withdrawals from wells screened in water-bearing sand and gravel of Pleistocene age accounted for 53 percent of the total pumpage for public supply and industrial use in the Huntington-Smithtown area.

UNDIFFERENTIATED DEPOSITS OF PLEISTOCENE AND PLIOCENE(?) AGE

In some of the deeper buried valleys of the project area, wells have penetrated sections of sand and gravel associated with bodies of silt and clay that may include equivalents of the Gardiners clay and the Jameco gravel of Pleistocene age and possibly the Mannetto gravel of Pliocene (?) age. As these deposits cannot be identified or defined areally on the basis of available faunal and lithologic evidence, they are grouped in undifferentiated deposits of Pleistocene age.

At well S16137T (see following log) in the South Huntington well field, an unusually thick section of these undifferentiated deposits was penetrated between depths of 202 and 604 feet (47 to 449 ft below sea level). The fine lignitic sand, silty clay, and clay between 202 and 407 feet may be an equivalent of the Gardiners clay. The remainder of the sand, gravel, silt, and clay sequence between 407 and 604 feet may include the Jameco gravel and possibly the Mannetto gravel.

At present (1960), well S16137 (pl. 4) is the only well known to tap the undifferentiated deposits. This well, screened from 540 to 602 feet in fine to coarse sand containing some gravel and clay, yields 1,400 gpm and has a specific capacity of 46 gpm per foot of drawdown.

UPPER PLEISTOCENE DEPOSITS

The upper Pleistocene deposits generally rest directly on the eroded surface of the Cretaceous deposits and form the bulk of the Pleistocene sequence in the Huntington-Smithtown area. In the northern part of the West Hills they lie on the Mannetto gravel of Pliocene (?) age, and in other places they lie on undifferentiated deposits of Pleistocene age. The upper Pleistocene deposits are thickest beneath the terminal moraines and in buried valleys, where in places they are more than 300 feet thick. The deposits include: (1) at least one and possibly two sheets of glacial till laid down directly as ground moraine by continental ice; (2) ice-contact deposits in the Ronkonkoma and Harbor Hill terminal moraines; (3) a considerable thickness of glaciofluvial deposits laid down by melt water streams in outwash plains and spillways during the advance, stagnation, and recession of the ice; and (4) discontinuous bodies of silt and clay laid down in glacial lakes and not exposed in the project area. The upper Pleistocene deposits are commonly brown, yellow, and gray.

A sheet of glacial till, generally less than 10 feet thick, forms a surficial mantle on most of the uplands of the project area north of the Harbor Hill end moraine. This till probably represents the ground moraine of the Harbor Hill ice. A second and older till sheet, largely buried but locally exposed in sand and gravel quarries in northwestern Nassau County, has been interpreted by Swarzenski (written communication; 1960) as the ground moraine of the Ronkonkoma ice. This till sheet also may be present in the Huntington- Smithtown area but has not been identified in outcrop or in well sections.

The Ronkonkoma and Harbor Hill terminal moraines are largely composed of crudely stratified sand and gravel deposits showing slump and collapse features and containing isolated masses of till. Isolated or coalescing kames and interspersed kettles account for the irregular surface of these moraines.

The bulk of the upper Pleistocene deposits is composed of stratified coarse sand and gravel laid down by melt water streams. Thick discontinuous bodies of silt and clay, however, are common in the buried valleys (pl. 4). These bodies are probably glaciolacustrine deposits, which may have formed during the recession of the Ronkonkoma ice and prior to the advance of the Harbor Hill ice.

The "clay unit of Smithtown," which underlies much of Smithtown (fig. 3), was considered by H. R. Blank (written communication, 1928) to be a possible equivalent of the Gardiners clay. The author believes, however, that the unit is probably a glaciolacustrine deposit in the upper Pleistocene sequence and may have been laid down in a glacial lake or lakes during the wasting of the Ronkonkoma ice. This unit is in a large buried valley, which lies in the eastern part of Smithtown. Its areal extent is only approximately defined by well data. Local continuity, however, is indicated by several wells in the Smithtown and Kings Park area (pl. 4 and fig. 3). In the adjacent areas it was either not deposited or it was removed by later stream erosion. Its upper surface generally lies above sea level and reaches a maximum altitude of 70 feet. The thickness is variable and ranges from a few tens of feet to 200 feet. The unit is predominantly clay, but some lenses of sand containing gravel and silt are found locally. The clay unit is generally brown or gray, which is characteristic of the upper Pleistocene deposits.

In many places a water-bearing sand and gravel zone (pl. 4) underlies this clay unit and is tapped by wells. The coarser materials are generally below sea level, and probably extend down to the underlying Cretaceous surface. At well S11810 in Smithtown, the sand and gravel zone rests on the Magothy (?) formation and is about 70 feet thick. Presumably, the sand and gravel were deposited by melt water streams during the advance of the Ronkonkoma ice.

An upper zone of gravelly stratified deposits commonly rests on the higher parts of the Cretaceous surface and on the Pleistocene clay bodies. This zone generally consists of yellow and brown layers of medium sand to coarse gravel containing a few boulder-size rock fragments. Rock fragments of igneous and metamorphic origin also are typically present. Much of this zone is not water bearing, as it lies above the zone of saturation.

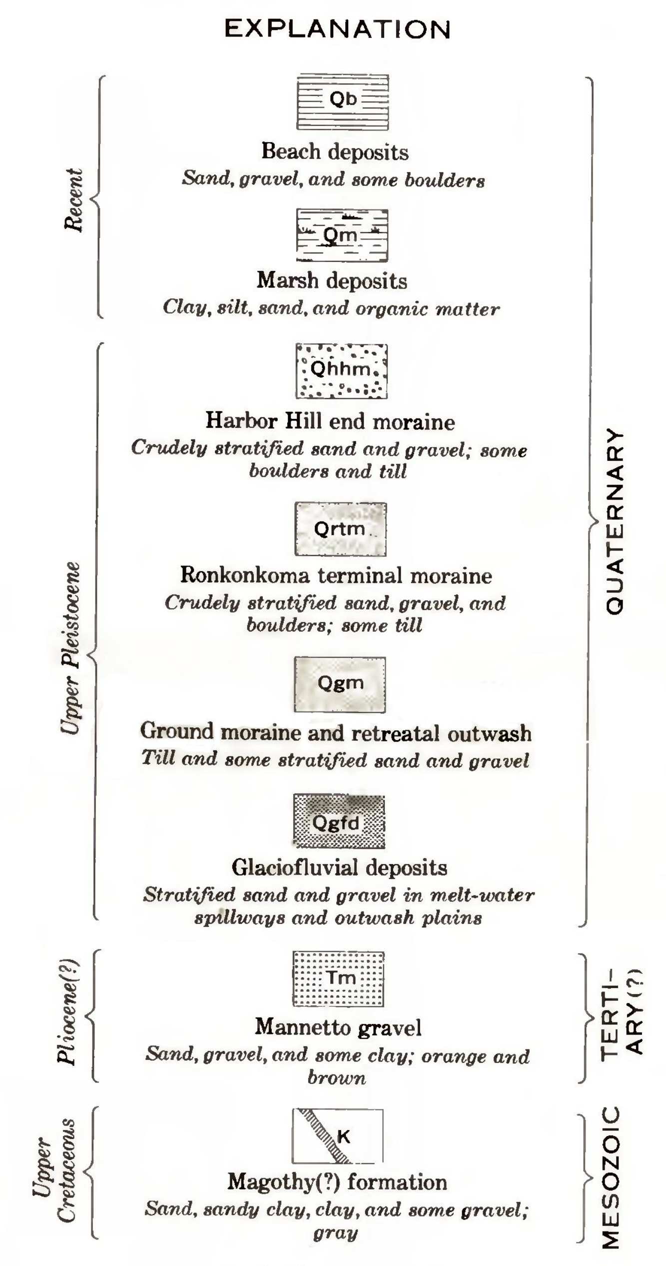
RECENT SERIES

Deposits of Recent age are not extensive in the Huntington-Smithtown area, and their thickness is rarely more than 20 feet. These deposits include beach sand and gravel, organic silt and clay in small ponds and marshes, and marine silt and clay in the north-shore bays and harbors. A soil zone of variable texture and generally less than 5 feet thick blankets the Pleistocene and Cretaceous deposits. The soil is characteristically loamy in most of the area, although in the central part of Smithtown it is somewhat sandy.

The water-yielding potential of the Recent deposits is small, owing to small areal distribution and thickness. The sand and gravel in the beaches and tombolos generally yield only brackish water, but in places the water is relatively fresh and is tapped by shallow driven wells for domestic supply. The marine silt and clay deposits in the north-shore bays and harbors act as aquicludes, which retard the landward encroachment of salt water and confine underlying fresh water in the coastal zones.

Extracted from: (Water-Supply Paper 1669-D).

WSP-1669-D Correlation



Extracted from: (Water-Supply Paper 1669-D).

WSP-1669-D Legend

Approximate geologic contact

Approximate center of populated area

Extracted from: (Water-Supply Paper 1669-D).

Water-Supply Paper 1825

Isbister, John, 1966, Geology and Hydrology of Northeastern Nassau County, Long Island, New York, U. S. Geological Survey, Water-Supply Paper 1825, 1:48000 scale (*GRI Source Map ID 27853*).

Note: The GRI digital geologic map for Sagamore Hill NHS used a subset of information from this publication. Additional aquifer and well data, as well as complete cross sections, can be viewed at the U.S. Geological Survey Publications Warehouse: http://pubs.er.usgs.gov/publication/wsp1825.

Plate 2 of 5 (Geologic contacts and units) and plate 3 of 5 (Structure contours) from Water-Supply Paper 1825 were used to produce the GRI digital geologic-GIS map for Sagamore Hill National Historic Site, New York (SAHI).

WSP-1825 Report

The following is an extract of geologic information from Water-Supply Paper 1825. Tables and figures referred to in this text are not included. To view tables and figures associated with Water-Supply Paper 1825, and a complete version of that publication, please go to the U.S. Geological Survey Publications Warehouse at: http://pubs.er.usgs.gov/publication/wsp1825.

SUMMARY OF STRATIGRAPHY

Northeastern Nassau County is underlain by unconsolidated coastal plain deposits of Cretaceous, Tertiary, and Quaternary age, which overlie igneous and metamorphic rocks of Precambrian age (table 1). The Cretaceous deposits are composed of interbedded lenses of gravel, sand, silt, and clay, which rest unconformably upon the bedrock. Two formations of Late Cretaceous age underlie the area. The oldest is the Raritan Formation. The overlying post-Raritan deposits of Cretaceous age have been assigned tentatively to the Magothy Formation but may include some younger formations which have not yet been differentiated in the report area (Perlmutter and Crandell, 1959, p. 1066). Deposits of Tertiary age are represented by the Mannetto Gravel, which the Geological Survey considers to be of Pliocene (?) age (Suter and others, 1949, p. 9) . Pleistocene deposits of pre-Wisconsin age are represented by the Jameco Gravel and the Gardiners Clay. Two advances of the ice during the Wisconsin Glaciation account for the till and outwash deposits, which comprise the upper Pleistocene deposits. Shoreline, marsh, and alluvial deposits of Recent age occur locally along the beaches and in some valleys. Sections AA'—CC'' (pl. 3) show the large variations in depth, thickness, and lithology of the geologic units in the report area. The lithology and correlation of the formations penetrated by a deep well at Plainview are given in table 2. This well was drilled to a depth of 1,246 feet through deposits of Pleistocene, Tertiary, and Cretaceous ages and partly into weathered bedrock of Precambrian age.

BEDROCK

Bedrock of Precambrian age underlies the unconsolidated sediments. A map of the bedrock surface based chiefly on scattered records of wells is given in Suter, de Laguna, and Perlmutter (1949, pl. 8). Logs are available for wells N119 and N120 in Locust Valley, N3355 in Plainview, and N7152 in Bayville which penetrate bedrock in the report area.

The upper part of the bedrock is decomposed or chemically altered, except possibly in some of the buried valleys along the north shore where the weathered zone may have been completely eroded during Pliocene or Pleistocene time. The weathered zone ranges in thickness from 5 feet to more than 100 feet, and a gradual transition from decomposed to fresh rock has been observed in core samples from a few wells in Nassau County. Well N7152 at Bayville (pl. 1) penetrated 17 feet of weathered bedrock without entering fresh rock; well S21119T, at West Neck in northwestern Suffolk County, about 1 mile east of the study area, penetrated 51 feet of weathered rock. The rock at both wells is weathered biotite schist. The weathered bedrock is composed chiefly of angular quartz and weathered biotite, chlorite, feldspar, and fragments of partly decomposed rock in a clay matrix.

The altitude and configuration of the bedrock surface are shown on figure 4 by contours that are controlled partly by data at four wells in the report area and partly by extrapolation of data from adjoining areas. The highest altitude of the bedrock surface is about 400 feet below sea level at the north shore near Lattingtown and Bayville; the lowest is about 1,200 feet below sea level in the extreme southeastern part of the report area near Farmingdale. The bedrock surface dips about 80 feet per mile to the southeast.

The displacement in the —500-foot contour near Bayville represents a north-trending buried valley, the presence of which is inferred chiefly from data on buried channels in the overlying deposits. If the valley trends north as the data imply, then it must also deepen to the north. Because the bedrock surface rises to the northwest, it follows that the bedrock surface and the valley must at some place intersect. Similar valleys are eroded into the bedrock in northwestern Nassau County and in northwestern Suffolk County. Existing information is generally too scanty to delineate all the erosional features and minor irregularities which undoubtedly exist on the surface of the bedrock. The bedrock is not a source of water but forms the virtually impermeable base of the ground-water reservoir. The porosity of the rock, including joints and fractures, is probably less than 1 percent.

UPPER CRETACEOUS SERIES

The Upper Cretaceous Series consists of unconsolidated interbedded sand, gravel, silt, and clay that rest unconformably upon the bedrock. The lithology of these deposits commonly varies within a short distance both horizontally and vertically; however, two formations of continental origin have been identified : (1) the Raritan Formation, which is divided into the Lloyd Sand Member and an unnamed clay member, and (2) the Magothy (?) Formation.

RARITAN FORMATION

LLOYD SAND MEMBER

The Lloyd Sand Member rests unconformably upon the weathered bedrock and is overlain in most of the area by the clay member of the Raritan Formation. The Lloyd Sand Member extends to the north an unknown distance beneath Long Island Sound, where it is covered either by the clay member or by deposits of Pleistocene and Recent age.

The Lloyd was removed by stream erosion in post-Cretaceous time in some deep buried valleys near the north shore, as at Locust Valley and Cove Neck (fig. 5). However, the data are too scanty to define the configuration of these valleys accurately. The upper surface of the Lloyd ranges from about 200 feet below sea level at Peacock Point in Lattingtown to 900 feet below sea level at South Farmingdale. The Lloyd dips about 60 feet per mile to the southeast and ranges from about 200 to 250 feet in thickness in most of the area.

The Lloyd Sand Member is a stratified deposit, comprising discontinuous layers of sand, gravel, sandy clay, silt, and clay. The sand and gravel beds are composed of yellow, white, and gray quartz, with a few percent of chert and other stable minerals. The quartz grains are angular to subrounded and the beds at some places contain varying amounts of interstitial clay. Lenses of white, gray, and buff silt and clay are common. Lignite occurs as scattered particles in beds of sand and clay and in thin layers.

Despite its relatively high clay content, the Lloyd Sand Member is a productive aquifer in Nassau County. On the basis of data from a pumping test in southern Queens County, Jacob (1941, p. 783-787) reported a coefficient of transmissibility of 190,000 gpd per ft (gallons per day per foot), a field coefficient of permeability of 900 gpd per sq ft, and a coefficient of storage of 0.0003. A reevaluation of the original pumping-test data by N. J. Lusczynski (oral commun., 1962), using the leaky-aquifer equation (Jacob, 1946) , suggests that the transmissibility and permeability may be about 100,000 gpd per ft and 500 gpd per sq ft, respectively. A coefficient of permeability of about 500 gpd per sq ft was computed from data obtained from a brief pumping test in southern Nassau County (N. J. Lusczynski and W. V. Swarzenski, written commun., 1962). Because of generally similar Ethology in the Lloyd throughout Nassau County, these coefficients are assumed to apply to the Lloyd in the report area. Table 3 gives field coefficients of permeability for the Lloyd Sand Member based on approximate coefficients of transmissibility estimated from specific capacities (Bentall, 1963, p. 331-340) of five public-supply wells and an assumed storage coefficient of 0.0003. Transmissibilities obtained by this method are probably lower than actual values because of the combined effects of partial penetration of the aquifer, possible head loss in the annular space, head loss due to turbulent flow in the aquifer near the screen, screen entrance loss, and other frictional losses inside the casing. It is possible that the permeability values in table 3 for wells N2602 and N5152 are low because the effective aquifer thickness may be less than the total formation thickness. However, available data are insufficient to substantiate this assumption.

An appraisal of the scanty data on the Lloyd in and near the report area suggests that the average horizontal permeability of the formation is about 400 gpd per sq ft.

Most of the wells screened in the Lloyd in the report area are used to supply estates and small homes and have a relatively low yield and capacity. The wells are at and near the north shore and on Centre Island where an adequate supply of good-quality water is generally unobtainable from shallower beds.

CLAY MEMBER

The clay member of the Raritan Formation rests on the Lloyd Sand Member. It is overlain nearly everywhere by the Magothy (?) Formation and locally by the Gardiners Clay and undifferentiated deposits of Pleistocene age (pl. 3) . The clay member underlies most of the project area and extends an unknown distance to the north beneath Long Island Sound (fig. 11) . It is missing in some deep buried valleys near the north shore (pl. 3) and probably beneath parts of Long Island Sound due to post-Cretaceous erosion.

The top of the clay member is generally parallel to the underlying Lloyd Sand Member and dips about 60 feet per mile to the southeast. The upper surface of the clay member (fig. 6) is thought to have low relief, except in the vicinities of Oyster Bay and Locust Valley, where it has been eroded and is entirely removed locally. At Lattingtown in the northwestern part of the project area, the top of the clay member is only about 70 feet below sea level; and in South Farmingdale to the southeast, it is more than 700 feet below sea level. The thickness of the clay member in the report area ranges from 0 to about 200 feet and averages about 150 feet. The clay member is composed chiefly of gray, red, white, and blue clay and silty clay and lenses of sand and gravel. Lignite and pyrite are common. The permeability of beds of clayey silt may be as low as 0.0002 gpd per sq ft (Wenzel, 1942, p. 11). Because of its extent and relatively low permeability, the clay member constitutes an effective confining unit for most of the Lloyd Sand Member.

MAGOTHY (?) FORMATION

The Magothy (?) Formation rests unconformably upon the Raritan Formation. The Magothy (?) underlies most of the area, but has been completely removed by erosion locally in the northern part (pls. 3-4). The formation is overlain by the Mannetto Gravel of Pliocene (?) age and deposits of Pleistocene age and is underlain by the clay member of the Raritan Formation.

The upper surface of the Magothy (?) ranges from about 100 feet below sea level to more than 200 feet above sea level. The highest altitudes occur on a northeast-trending buried ridge (pl. 4), which approximately underlies the Ronkonkoma terminal moraine. The formation crops out in a few places along the north shore, in scattered building excavations, highway and railroad cuts, and in the clay pits at Bethpage. The upper surface of the Magothy (?) has been extensively eroded and has as much as 300 feet of relief. Deep buried valleys are cut completely through the Magothy (?) Formation in the northern part of the area. Similar deep buried valleys were reported in northwestern Nassau County (Swarzenski, 1963) and in northwestern Suffolk County (Lubke, 1964). Probably a modified rectangular drainage pattern developed originally on the Magothy (?) surface. Subsequent streams eroded valleys parallel to the strike of the formation in less resistant beds, and the more resistant beds remained as ridges or cuestas. The present-day harbors of the north shore were probably cut largely by north-flowing streams and later were modified by glacial ice.

The Magothy (?) Formation in northeastern Nassau County ranges in thickness from 0 to 800 feet. The stratigraphic relations and variations in lithology and thickness of the Magothy (?) Formation are indicated on the geologic sections (pl. 3).

The lithology of the Magothy (?) is known almost entirely from well logs and samples of the formation collected during the drilling of wells inasmuch as the formation crops out only in a few places. The formation consists chiefly of interbedded gray, buff, and white fine sand and clayey sand and black, gray, white, buff, and some red clay. Gravelly zones are common near the bottom of the formation but are rare in the upper part. Angular to subangular quartz is the chief mineral in the sandy beds and is accompanied by varying amounts of clay minerals, chert, muscovite, and a small percentage of dark heavy minerals. Lignite and pyrite have been observed in many samples, and cemented concretionary layers of quartz and iron oxide are common.

The productive water-bearing zones in the Magothy (?) Formation consist of thin zones of sand and gravel, which occur at various depths as scattered, discontinuous lenses in the predominantly fine-grained material, and a thicker more extensive coarse-grained zone near the base of the formation. The basal coarse-grained zone is extensively distributed in the southern part of the area, but it is apparently not as extensive in the northern part. The basal zone is composed of coarse quartz sand and gravel, varying amounts of interstitial clay, and some layers of clay and sandy clay. The basal zone is usually less than 100 feet thick, and in some places it is very thin or entirely absent. Some wells, which tap the basal zone, yield as much as 1,400 gpm. Specific capacities of these wells generally range from about 15 to 45 gpm (gallons per minute) per foot of drawdown and in places are as high as 67 gpm per foot of drawdown.

Laboratory determinations of the porosity and permeability of six samples of sand from the Magothy (?) Formation obtained from wells drilled in the village of Hempstead, about 3 miles south of the project area, were made in 1938 by the hydrologic laboratory of the U.S. Geological Survey in Washington, D.C. The porosity ranged from 32 to 41 percent and averaged 38 percent; the permeability ranged from 500 to 1,450 gpd per sq ft and averaged 950 gpd per sq ft. The tests were made on disturbed, and in some cases washed samples, so these values are probably somewhat higher than those of the material in place. N. J. Lusczynski (written commun., 1962) reported permeabilities of 200 to 1,100 gpd per ft from pumping tests in wells screened in permeable zones of the Magothy (?) Formation in southern Nassau County and suggested that the permeability of some beds may be as high as 2,000 gpd per sq ft.

Field coefficients of permeability based on estimated thicknesses of water-bearing zones in the Magothy (?) Formation and computed from specific capacities of selected wells in the report area (table 4) , type curves developed by A. F. Meyer (in Bentall, 1963, fig. 100) , and an assumed coefficient of storage of 0.0005 range from about 600 to 1,200 gpd per sq ft and average about 1,000 gpd per sq ft.

These values are considered low because field conditions depart from the ideal assumptions of Meyer's method. An average permeability value for the entire formation thickness would be considerably lower because the supply wells for which specific capacities are known are open only to the more permeable zones of the Magothy (?) Formation. The thicknesses of the water-bearing zones in table 4 were estimated from an appraisal of electric logs, drillers' logs, and logs based on core descriptions.

Perlmutter and Geraghty (1963) used an average porosity of 25 percent and an average permeability of 500 gpd per sq ft in computing the velocity of ground water in the Magothy (?) Formation in southern Nassau County. On the basis of data from laboratory and field tests and a general appraisal of the thickness and Ethology of the Magothy (?), it is estimated that the average permeability of the entire Magothy (?) Formation in the report area is about 500 gpd per sq ft.

PLIOCENE SERIES

The only formation in the report area which has been tentatively assigned to the Pliocene Series of the Tertiary Period is the Mannetto Gravel. Some nonmarine deposits, which occur as valley fillings in the northern part of the area, may also be of Pliocene age, but the data are inconclusive. All these deposits of doubtful age have been designated undifferentiated deposits of Pleistocene age.

MANNETTO GRAVEL

The Mannetto Gravel of Pliocene (?) age (Suter and others, 1949, p. 9) is believed to be a stream-terrace deposit, which caps the Wheatley and Mannetto Hills (pl. 2). The strata are composed of undisturbed nearly horizontal beds of sand and gravel. The chief distinguishing features of the beds are their stratigraphic position, altitude, pronounced crossbedding, certain superficial features of the gravel, and the degree of weathering of the gravel and boulders. The Mannetto rests unconformably on the Magothy (?) Formation, forming a plateau like surface, which slopes gently to the south. The Mannetto Gravel of the Wheatley Hills area has a thin discontinuous cover of ground moraine, but the formation in the Mannetto Hills was apparently never covered by glacial ice.

The surface of the Mannetto Gravel ranges from about 160 feet to more than 300 feet above sea level and is considerably higher than the bordering Pleistocene outwash deposits. The thickness of the formation ranges from a few feet to about 220 feet (pl. 3). The beds are chiefly composed of well-rounded, usually deeply weathered, pitted iron-stained quartz gravel mixed with yellow to brown quartz sand. The gravel commonly ranges in diameter from 1/4 to 1 inch. In addition to the quartz the gravelly strata contains a few highly weathered pebbles and boulders of igneous and metamorphic rock in places. Layers of medium to coarse yellow to brown quartz sand and brown clayey silt are also interbedded with the gravelly zones.

Previous investigators (Fuller, 1914, p. 80-85 Veatch and others, 1906, p. 33-34; and Fleming, 1935, p. 219) considered the Mannetto Gravel to be of early Pleistocene age because locally it contains some crystalline rock fragments and minerals, which are rare to absent in the Cretaceous deposits. However, the predominance of quartz distinguishes the Mannetto from surrounding younger glacial deposits in which granite, gneiss, and other rock particles are usually much more abundant. The author agrees with Cooke, Gardiner, and Woodring (1943, chart 12) , Crosby (1910) , and MacClintock and Richards (1936, p. 320), who suggested that the Mannetto is probably older than Pleistocene. The Mannetto is possibly equivalent in age to the Beacon Hill Gravel (Pliocene ?) which was deposited under similar conditions in Monmouth County, N.J. (Lewis and Kimmel, 1915, p. 72-73).
The Mannetto Gravel occurs almost entirely above the water table and is of no importance as a source of water. Owing to the high permeability of the formation, water percolates downward relatively freely to the underlying Magothy (?) Formation.

PLEISTOCENE SERIES

Most of the surficial deposits in the report area are of Pleistocene age (pl. 2). The deposits are referred to two glaciations which were separated by an interglacial stade. The Jameco Gravel, a product of pre-Wisconsin glaciation, occurs locally along the north shore and possibly under Long Island Sound. The Gardiners Clay, also of pre-Wisconsin age, is an interglacial marine formation that rests unconformably on the Jameco Gravel. The remainder of the Pleistocene deposits is of Wisconsin age and is referred to collectively as the upper Pleistocene deposits. The upper Pleistocene deposits include two sequences of till and outwash which comprise the Ronkonkoma and Harbor Hill Drifts. Because of their wide range in permeability, thickness, and extent, the deposits of Pleistocene age have great influence on the occurrence and movement of ground water. The deposits of clay and till impede infiltration and downward percolation of water, creating perched-water conditions locally, whereas the highly permeable beds of sand and gravel offer little resistance to the movement of water.

JAMECO GRAVEL

The Jameco Gravel is an early Pleistocene outwash deposit, which was deposited by melt-water streams that flowed from a stagnating ice front north of present day Long Island (Veatch and others, 1906,p. 34). Because these streams had different sources, the composition of the sediments they transported varied widely. Beds of unconsolidated sand, gravel, and silt - which may be part of the Jameco Gravel - occur in some buried valleys in northeastern Nassau County. Unlike the characteristically dark heterogeneous Jameco Gravel beneath Kings and southern Queens Counties (Suter and others, 1949, p. 4041) , these beds vary locally in lithology. In some places the beds consist almost entirely of quartz and contain only a small percentage of igneous rock pebbles, but elsewhere, as at well N6675 on Cove Neck, granitic pebbles and cobbles constitute a major part of the beds.

The Jameco Gravel is overlain by the Gardiners Clay or beds of undifferentiated Pleistocene deposits. It is underlain either by deposits of Cretaceous age or by bedrock.

The driller's log of well N6675 (table 5) gives a representative description of the Jameco in a deep buried valley in the report area. The Jameco Gravel in this well is composed mostly of granitic sand, pebbles, and cobbles. A large piece of black limestone, bearing brachiopod fossils, was recovered from a depth of about 445 feet below sea level. The Jameco at the site of this well is overlain by Gardiners Clay, which is nearly 100 feet thick.

Deposits of undifferentiated valley fill of probable Pleistocene age which are found in some buried valleys may be equivalent, in part, to the Jameco Gravel. However, where the overlying Gardiners Clay is absent, a precise correlation cannot be made.

The Jameco Gravel and undifferentiated deposits of Pleistocene age are tapped by a few wells on the north shore. Hydraulic interconnection between the Jameco Gravel and the Lloyd Sand Member (pl. 3) is discussed in a later section.

Table 6 gives estimated coefficients of permeability of the Jameco Gravel at two wells in northwestern Nassau County (Swarzenski, 1963, pl. 1) and one well in the report area. These coefficients, which range from 100 to 800 gpd per sq ft were computed from transmissibilities determined from the specific capacities of the wells, an assumed storage coefficient of 0.0004, and an estimated thickness for the part of the aquifer tested. The permeabilities in table 6 may be either higher or lower than actual values because the thickness of the water-bearing zone cannot be readily determined and because of other limitations of the method.

GARDINERS CLAY

The Gardiners Clay is an interglacial marine formation, which occurs mainly as a fringing deposit along the north shore and at an unknown distance inland in some buried valleys. The Gardiners is underlain either by the Jameco Gravel (pl. 3) or by the Raritan Formation and is overlain by the upper Pleistocene deposits. The areal extent of the Gardiners is unknown in the report area because of scanty well data.

The top of the clay is normally 50 to 100 feet below sea level, but at one location (well N6675 pl. 1, 3) it is 230 feet below sea level. The Gardiners commonly ranges in thickness from 100 to 200 feet.

The Gardiners Clay is composed of brown to greenish-brown to gray clay and silt, interbedded with layers and lenses of sand and gravel. Quartz pebbles are dispersed in some clay beds; and peat, oyster and clam shells, Foraminifera, and diatoms are common.

Some water moves through the Gardiners Clay, but the formation generally acts as a confining unit for the underlying deposits and the rate of movement through it is probably low. Its effectiveness as a confining unit beneath Long Island Sound is unknown.

UPPER PLEISTOCENE DEPOSITS

The upper Pleistocene deposits include all the glacial deposits younger than the Gardiners Clay. Two bodies of drift, the Ronkonkoma and Harbor Hill, composed of till and related outwash deposits of Wisconsin age, were identified in northeastern Nassau County. Except on the Ronkonkoma terminal moraine, the Wheatley Hills, and possibly in an area southwest of the Mannetto Hills, the older Ronkonkoma Drift is either buried beneath the younger Harbor Hill Drift or else cannot be differentiated from it. Although the configuration of the underlying Cretaceous surface (pl. 4) exerts a strong influence in many places, the relief of the present land surface is mainly due to the deposits of the Harbor Hill Drift.

The wide range in the lithology of the upper Pleistocene deposits has considerable influence on the occurrence and movement of ground water in the report area. In areas underlain by till of relatively low permeability, the downward movement of water from precipitation is retarded; and perched and semiperched water occurs in many places. In areas underlain by permeable outwash, such as in Levittown, shallow wells, 80 to 125 feet deep, yield as much as 1,100 gpm and have specific capacities as high as 47 gpm per foot of drawdown. North of Glen Cove, deep wells screened in the upper Pleistocene deposits, yield as much as 1,100 gpm and have specific capacities as high as 44 gpm per foot of drawdown.

Laboratory analyses of several hundred samples of outwash from southern Long Island (Veatch and others, 1906, p. 354-360) indicate that the porosity of the glacial outwash probably ranges from 30 to 40 percent. Permeabilities of the outwash ranging from 1,000 to 1,600 gpd per sq ft and average 1,300 gpd per sq ft have been computed from pumping tests at Brookhaven National Laboratory in central Suffolk County (M. A. Warren and N. J. Lusczynski, written commun., 1955). The outwash in the report area south of the Ronkonkoma terminal moraine and in some of the buried valleys near Long Island Sound is lithologically similar to that of Suffolk County and probably has similar hydraulic characteristics. A pumping test (Lusczynski, 1949b) made in shallow wells in Hicksville, a short distance south of the report area, shows hydraulic interconnection between the outwash deposits and underlying permeable beds in the upper part of the Magothy (?) Formation. A coefficient of permeability of about 2,500 gpd per sq ft was computed from the test data on the basis of an assumed thickness of 100 feet for the zone tested. The average permeability of the outwash deposits in the report area is estimated to be 1,000 gpd per sq ft.

The outwash deposits are a minor source of water in most of northeastern Nassau County. However, in the village of Oyster Bay, where the Cretaceous formations have been deeply eroded and the outwash deposits are thick, the deposits constitute the primary source of water.

RONKONKOMA DRIFT

The Ronkonkoma ice sheet deposited a mantle of glacial drift on the Cretaceous and early Pleistocene deposits. The drift ranges from unstratified till to stratified outwash (pl. 2) and mainly occurs in three topographic forms : a ground moraine, a terminal moraine, and an outwash plain.

The basal beds of the drift are composed of stratified outwash deposited chiefly by melt-water streams emanating from the ice front as it moved slowly southward. These advance outwash deposits are predominantly sand and gravel and range in thickness from a few feet to about 100 feet. The deposits do not crop out and are not differentiated on the geologic map or sections in this report.

The ice gradually overrode its advance outwash deposits and moved to a maximum southward position indicated by the Ronkonkoma terminal moraine. The terminal moraine is a discontinuous line of hills trending generally northeast from Old Westbury to Woodbury (pl. 2). The hills are subdued in the southwest, where the summits are as high as 180 feet above sea level, but to the northeast the hills are steeper and are as high as 300 feet. The terminal moraine is composed of a series of coalescing alluvial fans and kames of stratified sand and gravel with subordinate amounts of till. Exposures in roadcuts and building excavations reveal slumping and crossbedding characteristic of ice-contact deposition. The total thickness of the terminal moraine deposits is as much as 200 feet.

South of the Ronkonkoma terminal moraine is a relatively flat out-wash plain, which extends beyond the south limit of the report area to the south shore of Long Island. The outwash plain is underlain by stratified sand and gravel deposits ranging from 80 to 100 feet in thickness. These deposits are lithologically similar to the advance out-wash and to some parts of the terminal moraine but generally cannot be differentiated from the younger Harbor Hill outwash. Hence, the outwash deposits shown on plate 2 south of the Ronkonkoma terminal moraine are designated as undifferentiated outwash deposits.

Fuller (1914, pl. 1) mapped one small area south and west of the Mannetto Hills as outwash from the Ronkonkoma ice sheet. His mapping may be correct as a few exposures in this area, observed in building excavations, indicated a much greater ratio of dark rock fragments to quartz pebbles than is commonly observed in the outwash elsewhere. Melt-water streams flowing from the Harbor Hill ice were possibly diverted from the area by the Mannetto Hills and a lobe of the Ronkonkoma terminal moraine. However, it is impossible to map the lateral limits of this deposit of Ronkonkoma outwash as the area is now extensively developed.

The Ronkonkoma ice sheet overrode its terminal moraine at least for a short distance and then retreated to the north, depositing a mantle of ground moraine in its wake. Till crops out on the summits of the terminal moraine and the Wheatley Hills but is covered by younger Harbor Hill outwash deposits everywhere else. The till is more deeply buried to the north and is identified in only a few well logs. The till ranges in thickness from about 5 to 20 feet and generally consists of the compact clayey or sandy-boulder type. Cobbles, and boulders as large as several feet in diameter, are commonly found in the till. The ground moraine contains small discontinuous lenses of clay and silty clay which indicate the bottoms of small temporary glacial lakes and kettles.

The sand and gravel deposits are predominantly quartz with a large percentage of fresh to weathered rock fragments and dark minerals. Biotite, hornblende, and augite are especially common. The quartz grains are subangular to subrounded and are frequently iron stained. The clayey parts of the till are generally brown to gray. The washed residue usually contains a large percentage of biotite and chlorite.

HARBOR HILL DRIFT

The Harbor Hill Drift comprises the uppermost beds almost everywhere beneath the land surface of northeastern Nassau County and is only overlain locally by Recent deposits. The drift consists of outwash and till.

Advance outwash deposits from the Harbor Hill ice sheet thinly mantle the Ronkonkoma ground moraine north of the Ronkonkoma terminal moraine. The deposits consist chiefly of sand and gravel and rarely exceed 50 feet in thickness.

The Harbor Hill end moraine (pl. 2) is an irregular ridge of hills about 1/2 to 34 mile north of, and generally parallel to, the Ronkonkoma terminal moraine. The Harbor Hill moraine was formed at the terminus of the ice sheet, but is classified as an end moraine because it does not mark the maximum advance of the ice sheet. The hills rise as high as 340 feet above sea level to the southwest, but descend eastward gradually until they scarcely rise above the surrounding thick outwash deposits near Cold Spring Harbor. The beds are steeply inclined in many places and consist of poorly stratified sand and gravel containing some boulders and patches of till. The end moraine is composed mainly of a series of coalescing kames. Its upper surface is irregular and is marked by numerous kettles and depressions. The end-moraine deposits have a maximum thickness of about 200 feet.

The outwash plain which extends south from the end moraine to the Ronkonkoma terminal moraine ranges in thickness from a few feet to about 100 feet. Its surface is irregular and includes numerous kettles, depressions, and small hills which are probably kames. This feature is termed a pitted outwash plain (pl. 2). South of the Ronkonkoma terminal moraine the outwash is generally indistinguishable from the older Ronkonkoma outwash deposits because the two outwash sequences are not separated by a layer of till, and the source of the detritus, mode of deposition, and character of the bedding are similar. Presumably, some outwash from the Harbor Hill ice was deposited, perhaps in fans or deltas, by streams which breached the Ronkonkoma terminal moraine, but this has not been positively determined either in the field or from well logs and samples.

The ground moraine comprises the surficial deposits nearly everywhere in the report area north of the terminal moraine. The deposits commonly range from about 5 to 20 feet in thickness and contain numerous cobbles and large boulders in a clayey or sandy, clayey matrix.

The sand and gravel beds consist mostly of quartz mixed with large amounts of metamorphic and igneous rock fragments. The individual grains are subangular to subrounded and are commonly iron stained. Dark minerals including biotite, hornblende, and augite are common.

Beds and lenses of clay are commonly brown, gray, and black and usually contain large quantities of biotite.

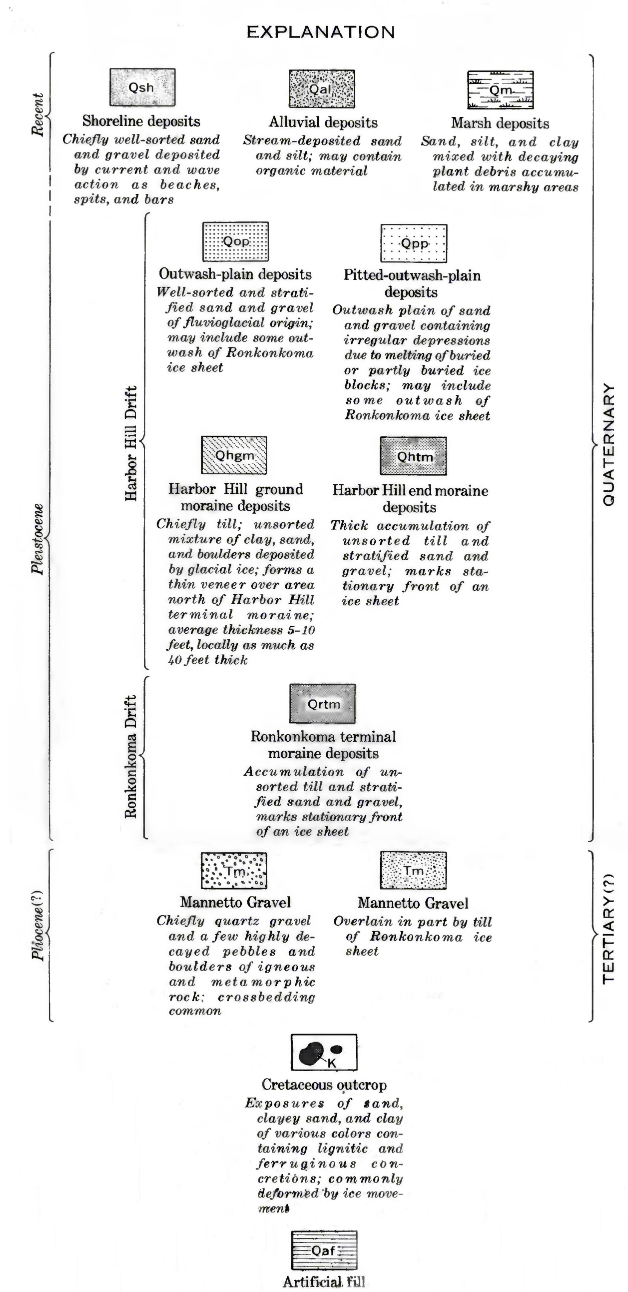
RECENT SERIES

The Recent Series consists of sand, gravel, silt, and clay deposited sporadically in valleys, swamps, marshes, beaches, and sandbars and beneath Long Island Sound and nearby bays (pl. 2). Locally, these beds are composed of reworked Cretaceous and Pleistocene deposits.

Recent deposits are not used as a source of fresh water because they generally either occur above the water table, contain salt water, or are so close to salt water that pumping from them would induce rapid intrusion of salty water. The beds of silt and clay, which are presently accumulating in Long Island Sound and its harbors, form an important seal that retards both leakage of fresh water from underlying strata and encroachment of salt water into them.

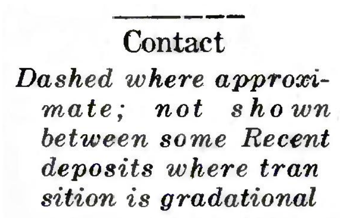
Extracted from: (Water-Supply Paper 1825)

WSP-1825 Correlation



Extracted from: (Water-Supply Paper 1825)

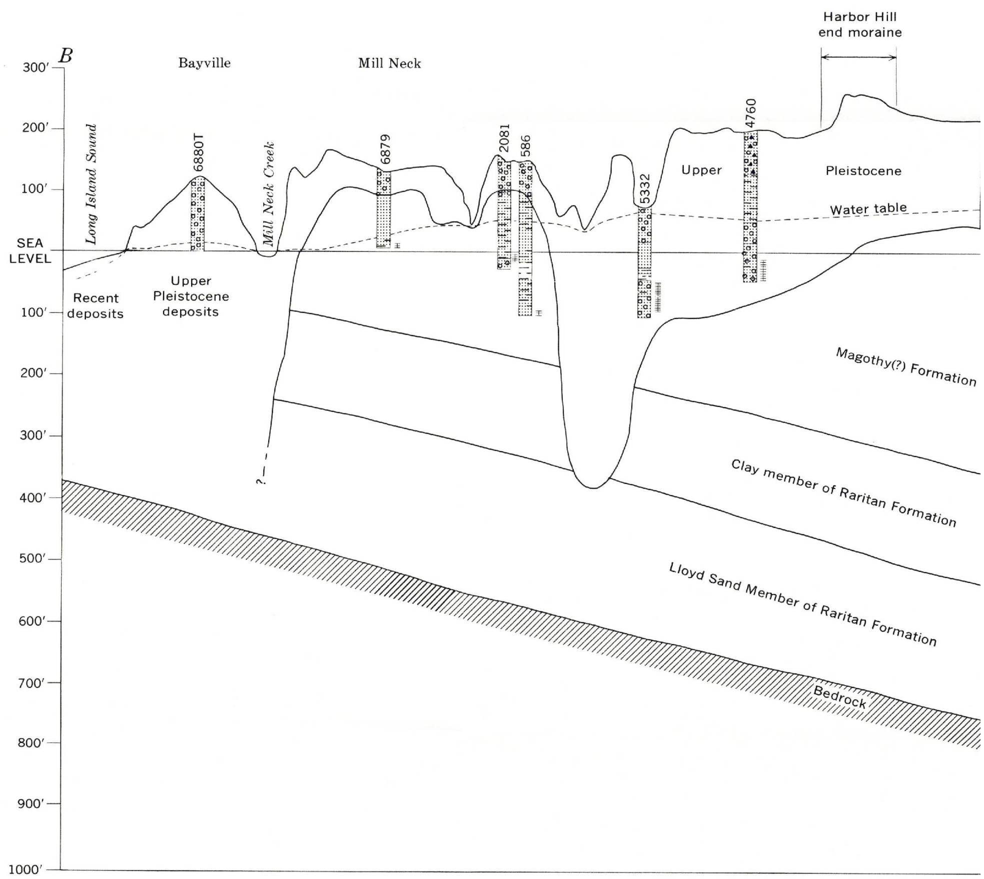
WSP-1825 Legend



Extracted from: (Water-Supply Paper 1825)

WSP-1825 Cross Section

Cross sections from this publication only partially intersect the area of interest that was extracted for the GRI Sagamore Hill NHS map. The section below has been partially included to convey subsurface stratigraphic relationships within the GRI map extent. This cross section intersects the GRI Sagamore Hill NHS map approximately from "B" to well "4760". Water-Supply Paper 1825, plate 3, contains three cross sections.



Extracted from: (Water-Supply Paper 1825)

GRI Digital Geomorphologic Map for Sagamore Hill NHS and Vicinity

Map Unit List

The geomorphic units present in the digital geologic-GIS data produced for Sagamore Hill National Historic Site, New York (SAHI) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qaf - Artificial fill). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geologic Unit Information (SAHGUNIT) table included with the GRI geology-GIS data. Unit symbols were assigned by GRI because geomorphic units in source data were presented with a unit name and no original symbol was given.

Cenozoic Era

Quaternary Period

Anthropogenic Features
Qaf - Artificial fill

Coastal Features
Qb - Beach
Qcs - Coastal scarp/bluff
Qw - Wetland

Spit Features
Qag - Active gravelly ridge
Qig - Inactive gravelly ridge
Qir - Inter-ridge swale

Fluvial/Colluvial Features
Qdm - Dissected ground moraine
Qfc - Fluvial/colluvial deposits

Glacial Features
Qpm - Planar ground moraine
Qke - Kettle
Qka - Kame

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below.

Qaf - Artificial fill (Quaternary)

Sediment manipulation at the coast, at the southern boundary of SAHI, has created a ridge of about 3 m elevation that has limited the migration of the tidal creek lying inland of the spit. The fill is part of the dredge spoil emanating from the creation of the boat basin south of SAHI. It is a higher elevation noted on the LiDAR and identifiable on the ortho-imagery. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

Qb - Beach (Quaternary)

The surface expression of the beach is a free sand surface that slopes seaward into the water, it extends from water level to a few decimeters above high tide. It is free of vegetation. It is identified as the bare sand unit adjacent to the water on the orthophotography. It has a series of small projections and embayments in the shoreline that are related to pulses of sedimentation and erosion that progress from north to south along the spit face. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

Qcs - Coastal scarp/bluff (Quaternary)

At some stage in the evolution of this area, waves and currents reached the eastern margin of the ground moraine and eroded this location to create a steeply-sloping scarp or bluff, essentially truncating the ground moraine topography. From both a process perspective and feature perspective, a new round of geomorphological development ensued that represented the mobilization of glacial deposits and the production of features created by the ambient waves and currents. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

Qw - Wetland (Quaternary)

A salt marsh lies immediately inland of the spit and seaward of the several alluviated stream valleys. The salt marsh is adapted to the present sea level position. Its distribution is well displayed on the ortho-imagery. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

Qag - Active gravelly ridge (Quaternary)

Immediately inland of the beach is the ridge/foredune that is vegetated and has an admixture of fine sand incorporated with the coarser beach sediments. The active gravelly ridge extends along the length of the spit, immediately inland from the active beach. The active gravelly ridge has a crestal elevation on the order of 2 m above NAVD88. The feature is identified on the orthophotography as the linear change from bare sand to some vegetation inland from the beach. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

Qig - Inactive gravelly ridge (Quaternary)

Along most of the spit, an older ridge/foredune feature is present. It represents a former shoreline position and a stage in the evolution of the spit. It has similar height and breadth dimensions as the active gravelly ridge. It is vegetated and extends along the inland margin of the spit. It is a linear vegetated feature on the orthophotography, and apparent in the field visit. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

Qir - Inter-ridge swale (Quaternary)

A topographical low separates the active and the inactive gravelly ridges. The swale is broader near the distal end of the spit and decreases in width toward the north. It is on the order of 0.5 m lower than the ridges. The linear characteristic is identifiable on the orthophotography, and is observed in the field. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

Qdm - Dissected ground moraine (Quaternary)

The margins of the planar ground moraine are locations of steep slopes that sharply alter the elevation of the general surface. Headward erosion by small intermittent streams has produced a dissected edge that is more abrupt on the southern and eastern margins than on the western side. The margins are derived from the LiDAR slope portrayal and the soils maps that include slope as a basis for soil type. The large kettle feature on the eastern flank of the planar ground moraine has a series of small drainage channels leading to a central depression. Colluvial processes, overland flow, and channelized flow have and are actively dissecting the margins of the glacial ground moraine. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

Qfc - Fluvial/colluvial deposits (Quaternary)

Sediment has accumulated at the base of the steep slopes to create a planar surface that is the product of the erosional processes mobilizing the margins of the glacial moraine. These deposits create an alluvial plain at the bottom of the stream valleys etched into the planar ground moraine. They are identified as a change in slope (steeper to less steep) to produce a relatively-flat, low-lying surface on the LiDAR image and as a bottomland soil on the soils map. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

Qpm - Planar ground moraine (Quaternary)

The oldest and generally highest portion of the site, depicted as a broad, high surface derived from DEM and contours produced by the LiDAR data set and is coincident with a sandy soils series on the soils map. It is a relatively flat surface composed of ground moraine associated with the Harbor Hill recessional stage. The surface slopes down gently from west to east. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

Qke - Kettle (Quaternary)

These are depressions or topographical lows within the ground moraine; they represent portions of the ground moraine that incorporated blocks of ice that later melted and caused the formation of isolated depressions in the gently-undulating surface. They are identified primarily from the elevation and steeply-sloped, enclosed depressions created from the LiDAR data. A large depression on the eastern margin of the ground moraine may be a coalescing of several kettles. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

Qka - Kame (Quaternary)

A glacial deposit that creates a localized high ground, a hill, on the general ground moraine surface, identified on the LiDAR image as a small hill rising above the general elevation of the planar ground moraine. A series of closed contours identifies its extent. This feature forms the highest portion of the Sagamore Hill site. (*GRI Source Map ID 75635)* (Geomorphological Map of Sagamore Hill NHS).

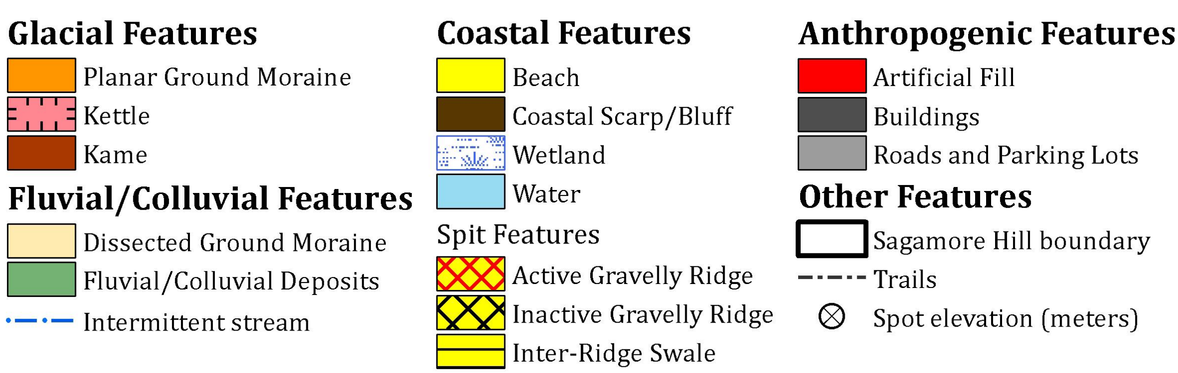
Geomorphological Map of Sagamore Hill NHS

Psuty, N. P. et al., 2014, Geomorphological Map of Sagamore Hill National Historic Site and Vicinity, New York: Institute of Marine and Coastal Sciences, Rutgers University, Sandy Hook, NJ, unpublished digital data and map, scale 1:6,000 (*GRI Source Map ID 75635*).

Geomorphological Map Index Figure

Extracted from: (Geomorphological Map of Sagamore Hill NHS).

Geomorphological Map Legend



Extracted from: (Geomorphological Map of Sagamore Hill NHS).

GRI Digital Data Credits

This document was developed and completed by Derek (Colorado State University) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory (GRI) Program. Quality control of this document by Jim Chappell (Colorado State University).

The information in this document was compiled from GRI source maps, and intended to accompany the digital geologic-GIS maps and other digital data for Sagamore Hill National Historic Site, New York (SAHI) developed by Derek Witt (Colorado State University) (see the GRI Digital Maps and Source Map Citations section of this document for all sources used by the GRI in the completion of this document and related GRI digital geologic-GIS maps).

GRI QC and finalization by Jim Chappell (Colorado State University).

GRI program coordination and scoping provided by Bruce Heise and Tim Connors (NPS GRD, Lakewood, Colorado).